JOURNAL OF APPLIED BEHAVIOR ANALYSIS 2011, **44,** 157–161 NUMBER 1 (SPRING 2011)

GENERALIZATION OF POSTURE TRAINING TO COMPUTER WORKSTATIONS IN AN APPLIED SETTING

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Improving employees' posture may decrease the risk of musculoskeletal disorders. The current paper is a systematic replication and extension of Sigurdsson and Austin (2008), who found that an intervention consisting of information, real-time feedback, and self-monitoring improved participant posture at mock workstations. In the current study, participants worked in an applied setting, and posture data were collected at participants' own workstations and a mock workstation. Intervention in the mock setting was associated with consistent improvement in safe posture at the mock workstation, but generalization to the actual workstation was limited.

Key words: ergonomics, musculoskeletal disorders, real-time feedback, self-monitoring

Incorrect work posture may result in work-related musculoskeletal disorders (Kroemer & Grandjean, 1997; U.S. Occupational Safety and Health Administration [OSHA], 2008b) that include soft tissue injuries or disorders of the muscles, nerves, tendons, joints, cartilage or spinal discs (Gerr, Marcus, & Monteilh, 2004; Matias, Salvendy, & Kuczek, 1998). Sigurdsson and Austin (2008) used an intervention package that consisted of safety information, real-time visual feedback, and self-monitoring of posture at a mock workstation to improve the posture of participants who were recruited from an undergraduate psychology class. Tittelbach, Rost, and Alvero (2009) replicated Sigurdsson and Austin (2008) by assessing the effects of still-picture (snapshot) feedback of various participant postures at 50-s and 120-s intervals, with and without self-monitoring. Both feedback intervals resulted in an increase in safe posture; however, self-monitoring did not result in further improvements. These studies identified intervention components that improved posture in a mock setting; however, this research did not assess generalization of training effects from the mock setting to the participants' actual workstations.

The purpose of the current study was to replicate and extend systematically the work of Sigurdsson and Austin (2008) in an applied work setting. Each participant was observed at his or her actual workstation and at a mock workstation. The treatment package was administered at a mock workstation, and generalization effects were assessed at participants' actual workstations where the intervention package had never been delivered.

METHOD

Participants and Setting

Participants were one female and two male trainees at the Center for Learning and Health (CLH). The mission of CLH is to reduce drug use and poverty by providing chronic drug users

This research was supported by Grants RO1DA019497 and RO1DA019386 from the National Institute on Drug Abuse. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institute on Drug Abuse or the National Institutes of Health.

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doi: 10.1901/jaba.2011.44-157

with vocational training and paid employment as a contingency to compete with drug use (e.g., Silverman, 2004).

Experimental Task

Participants engaged in typing tasks at their actual workstations and at a mock workstation. At actual workstations, participants completed a typing training program (e.g., Dillon, Wong, Sylvest, Crone-Todd, & Silverman, 2004) and earned base pay in addition to productivity pay for characters typed correctly. Postures were scored as safe or at risk only while participants were typing and not during other computer tasks (e.g., using the mouse). The mock workstation task was identical to the typing task in Sigurdsson and Austin (2008). Participants could not earn productivity pay while they worked at the mock workstation; however, they continued to earn base pay plus $2 for every feedback session. Each mock workstation session was 20 min in duration.

Workstation Setup

During participants' first day at CLH, staff informed them of the OSHA (2008b) ergonomic guidelines for computer workstations, but each participant was allowed to set up his or her own workstation as he or she preferred. When a participant typed at the mock workstation, the workstation was set up to reflect that participant's actual workstation arrangement. To achieve this, research assistants measured the height of the chair, armrest, and chair back, the tilt of the keyboard tray, and the distance of the monitor to the edge of the desk at the participant's actual workstation prior to every session at the mock workstation.

Response Measurement and Interobserver Agreement

The dependent variable was leg posture. The definition for safe leg posture was based on OSHA (2008a) guidelines. Legs were scored as safe if the upper legs (thighs) were parallel to the floor and the lower legs were vertical to the floor with a 90° to 110° angle between the upper and lower legs. Five trained research assistants observed participants at their actual workstations for approximately 7 min per session. Research assistants were seated approximately 1 to 2 m from the participant and had an unobstructed view of the participant's body and workstation during the observations. The observers used a discontinuous 5-s whole-interval measurement system to record leg posture. Leg posture was scored every 40 s (to allow recording of other measures not reported in this study), for a total of 10 times per session. Percentage of intervals with safe leg posture for actual workstation sessions was calculated by dividing the number of samples scored as safe by the total number of samples.

At the mock workstation, leg posture was recorded on a webcam that focused on participants' legs while they were engaged in the typing task. Snapshot pictures (samples) were taken approximately every 15 s, and 80 samples were generated per session. Observers scored each picture as safe or at risk to determine the percentage of intervals with safe leg posture for mock workstation sessions. Percentage of intervals with safe leg posture was calculated by dividing the number of samples scored as safe by the total number of samples.

Interobserver agreement data were collected during 28% to 37% of sessions (across participants) at actual workstations and for 100% of sessions at the mock workstation. Interobserver agreement was determined by dividing the number of intervals with observer agreement by the total number of intervals with observer agreement and disagreement and multiplying by 100%. Agreement ranged from 95% to 100% (M = 98%) for all participants at actual workstations and from 98% to 100% (M = 99%) for all participants at the mock workstation.

Phases and Design

Prior to the information-only condition, CLH staff read a handout describing ergonomic safety (OSHA, 2008b) to all participants. Participants had to read the handout with the staff member. The handout described general ergonomic safety for all parts of the body, including safe leg posture. This was the only time participants received information in this phase. (This differs from Sigurdsson & Austin, 2008, who provided ergonomic safety information before every typing session in the information-only phase.) Prior to each observation session, observers informed the participant that a session was beginning and would last approximately 7 min but provided no additional instructions.

The intervention consisted of discrimination training, self-monitoring, and real-time feedback during a typing task. The experimenter implemented the intervention only at the mock workstation and followed the procedure used by Sigurdsson and Austin (2008). Specifically, the participant received verbal safety information about the dependent variable and then completed a discrimination task, which involved the participant stating whether pictures of leg posture depicted safe or at-risk posture. The participant had to respond correctly to all pictures prior to starting the typing task and was given corrective verbal feedback contingent on errors. After the participant began the typing task, a live video feedback window appeared in the bottom right corner of the computer screen at regular intervals. When the window appeared, the participant scored his or her own leg posture as safe or at risk on a self-monitoring window that appeared simultaneously with the live video feedback. The participant was instructed to score the first image he or she observed in the feedback window. After the participant scored leg posture as safe or at risk, the windows closed, and the participant continued the typing task. This study differed procedurally from the Sigurdsson and Austin study in that the real-time video feedback and the self-monitoring prompt appeared every 90 s rather than every 50 s. Participants never received any component of the intervention at their actual workstations. We used a concurrent multiple baseline design to evaluate the effects of the intervention package on safe leg posture during actual workstation sessions.

RESULTS AND DISCUSSION

Figure 1 depicts results of the information-only and intervention phases for all participants. After the intervention was introduced, participants reliably demonstrated safe leg posture at the mock workstation, but leg posture at the actual workstations was variable. Participant 1 had a low mean level of safe leg posture during the information-only condition ($M = 10\%$) but displayed a large and stable increase in performance at the actual workstation when the intervention was introduced at the mock workstation ($M = 82\%$). Participant 1 also had a fairly high mean level of safe leg posture at the mock workstation ($M = 66\%$). However, it should be noted that this mean is based on just two of the three feedback sessions that occurred because the camera malfunctioned during one session and did not capture any still pictures, although the feedback window still appeared on the computer screen.

Participants 2 and 3 also had low levels of safe leg posture during the information-only condition ($M = 0\%$ and $M = 5\%$ for Participants 2 and 3, respectively). Both participants had variable levels of safe leg posture during the intervention at their actual workstations ($M = 27\%$ and $M = 42\%$), and they demonstrated very high levels at the mock workstation ($M = 99\%$ and $M = 96\%$).

The current study yields findings similar to those of Sigurdsson and Austin (2008) and Tittelbach et al. (2009), showing that real-time video feedback at a mock workstation may lead to increases in safe posture in the mock setting. However, this study also showed limited generalization of intervention effects to participants' actual workstations. This suggests the need for additional research to identify variables

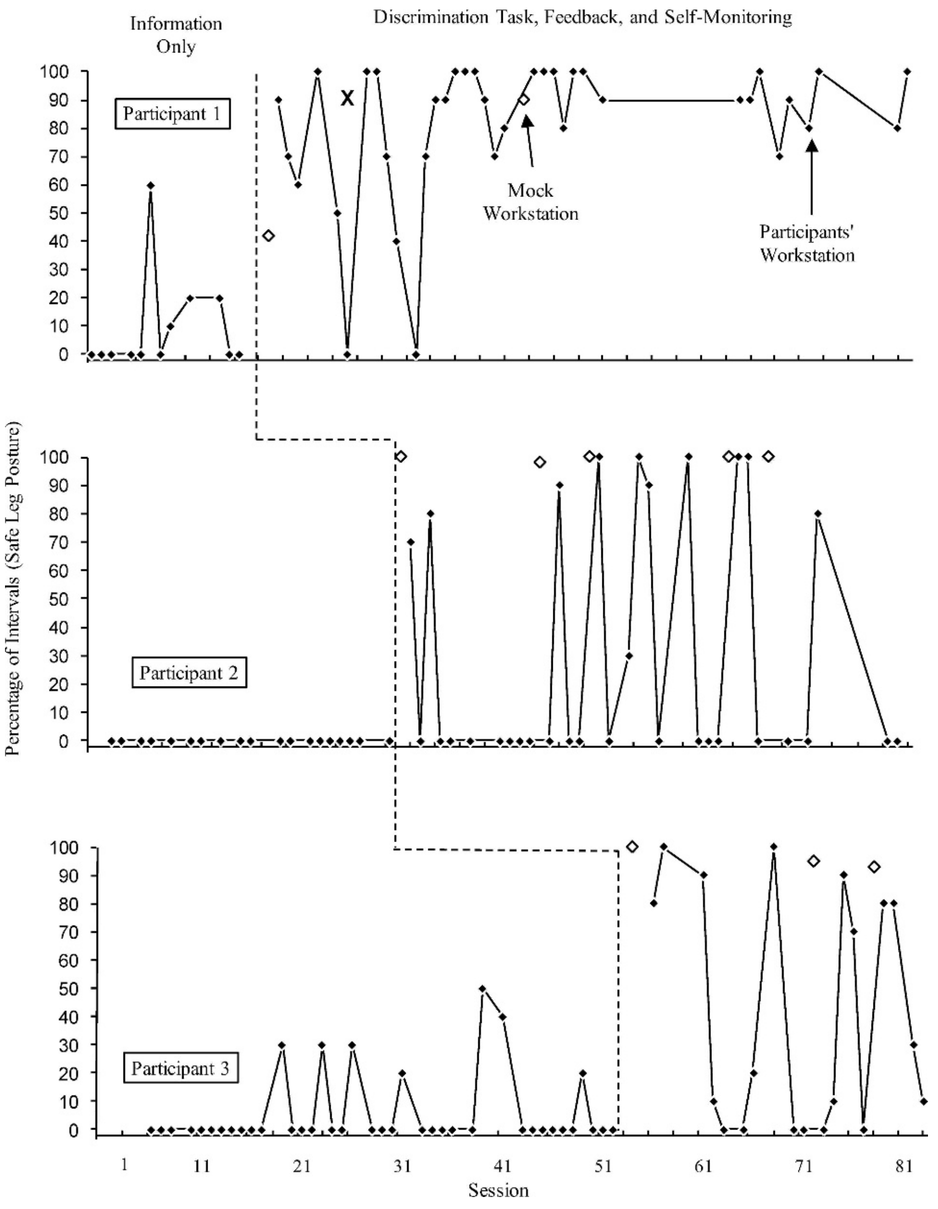

Figure 1. Percentage of intervals with safe leg posture for all participants. The X in the top panel indicates a feedback session during which posture could not be scored due to technical problems.

that would facilitate generalization from mock to actual workstations as well as cost-effective interventions that could be implemented at the actual workstation. For example, researchers may assess the effects of longer exposures to the mock workstation. Alternatively, feedback or monetary incentives for safe posture could be provided intermittently at participants' actual workstations to motivate safe postural behavior learned at the mock workstation.

One limitation of the current study is the absence of baseline data collected at the mock workstation, which limits interpretation of the effects of the intervention in that setting.

However, the study showed clearly that fairly brief postural training at mock workstations alone did not lead to improvements in posture at actual workstations and that maintaining variables have to be considered in the actual work environment after training. Finally, reactivity to observation may have contributed to improved performance; the camera was apparent at the mock workstation, and two observers were visible at the actual workstations. Generalization and maintenance of performance captured with covert observation would provide more compelling evidence.

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Received September 16, 2009
Final acceptance April 13, 2010
Action Editor, Rachel Thompson